SCIENCE

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ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY[1]

By Sir WILLIAM BRAGG

DIRECTOR OF THE ROYAL INSTITUTION

ACCORDING to our honored custom I preface this annual address by references to those of our fellows whom death has taken from us during the past year.

The past year has included many events which might well be mentioned in this annual address. One of them has, however, elbowed out most of the rest. The two numbers of *Notes and Records* which have begun a new enterprise contain interesting and informative accounts of our doings since last November. I believe that fellows have appreciated this social and intimate addition to the publications of the society, and that they will join with me in an expression of our gratitude to the officers who have produced it, and especially to the one who has on this, as on so many occasions, taken the lion's share of the work. The doings of the society are noted and recorded in this periodical more effectively than I could do in a presidential address.

I must now speak of an event which is surely uppermost in the minds of all who have received the nominations of council for next year. We are to lose the services of Sir Frank Smith. You may be surprised at his decision not to seek renomination when we would gladly have kept him for one more year. It happens, however, that two more of our officers must step down at the end of next year, and Sir Frank has pointed out that if three were to leave at one time the business of the society might be seriously affected. We can not, therefore, ask him to stay. We must take advantage of the opportunity thus given us to tell him how grateful we are for the work he has done for the society. His secretaryship has been distinguished by a rare exhibition of capable service. The place which the society fills in public life and its harmonious cooperation

[1] Given at the anniversary meeting on November 30, 1938. The address also contained obituary appreciations of the fellows who died during the year.

with other institutions are largely due to his wisdom and tact and his power to unite workers in a common effort. Indeed, it is impossible to think of what he has done for us, without reflecting at the same time that he has exercised his talents in a wider field, and that in the words that may seem simple but are full of meaning, he has been and is still, I am glad to say, a great public servant.

I should like to add a reference to one very interesting matter. As the result of a discussion between Dr. Krüss, head of the Prussian State Library in Berlin, and myself, when he attended the International Documentation Conference at Oxford in September last—a discussion initiated by Dr. Krüss—I have lately received a letter from Dr. Bosch, president of the Kaiser Wilhelm Gesellschaft, inviting the cooperation of the Royal Society in some scientific enterprise which would advance science and, at the same time, promote understanding and good will. Dr. Bosch asks that a few representatives from this side should be the guests of the Kaiser Wilhelm Gesellschaft for a week during this winter and hopes that we would play the part of hosts in return. During these interchanged visits, lectures would be given and consultations would be held; and it is reasonably to be hoped that some plan of a joint work would emerge. I feel sure that this gesture of friendliness will receive a warm welcome from the fellows of the society.

I will now say a few words on a subject which seems to me to exhibit a greater importance the more closely it is examined.

In recent years the very great increase in the output of the results of research has placed our scientific societies in a difficult position. There is correspondingly more to be published, and, at the same time, publication costs have increased. Consequently, the societies' finances are overstrained, and publication of worthy material is restricted. The Royal Society receives a government grant for publication purposes, far the greatest part of which is passed on to other societies. The grant is sufficient to meet only a portion of the applications for assistance that are made.

There is another reason why the increase in output presses hardly on our societies. In order that a proper standard of merit shall be maintained, it is customary to submit each paper, when it is sent in, to one or more referees. Now the number of possible referees is limited, and is even becoming relatively smaller as specialization increases. I may take this opportunity of expressing the gratitude of the society to those fellows who spend so much care on the examination of the papers submitted to them. The officers realize regretfully that they ask them for a considerable fraction of their time and energy.

Our shelves display the effects of increase. As we look at the long rows of bound periodicals in our studies, we realize not only that many years have slipped past since we began to collect them, but also that their very appearance is an item of history. A long time ago they were comparatively small and thin. But they grew: they shrank during the bad years of the war, but soon resumed their increase, and of late they have swollen until they have become unmanageable and must needs be divided. Still the papers come pouring in, and the rate of flow even increases. It is all to the good, and a healthy growth which we do not want to check; but there are practical difficulties which invite an attempt to solve them.

It seems to me that when we try to consider this matter from points of view all round it, we are driven to seek for a precise answer to the questions, "Why *do* we publish? Why do we submit papers and why does the society print them, if they are good enough?"

When a man submits a paper to the society he is, in the first place and quite rightly, anxious for the satisfaction of showing what he has done to those who will understand it. Another reason which has certainly grown in strength of recent years is that he wants to establish his reputation and position. Doubtless, he has also the wish that his work may be of service, though this desire may be relatively less obvious even to himself. To the society the opportunity for service is the principal reason; for it can not be held that the society exists in these days, only or even mainly, for the pleasure and profit of its fellows.

The existence of our society depends on our belief that knowledge is to be obtained by experiment. In that belief our founders of nearly three hundred years ago organized the rules and procedure on which we have acted ever since. Their foresight has been amply justified; but they could not have imagined how far experiment would carry their successors and others who have held the same belief. We have been led to the discovery of a natural world of vast extent; and without limits that we can see. Every part of it is of interest and every item of knowledge that we find there has a bearing on what we think and do. As we see and know, the results of the exploration have already been immense; modern life has been profoundly affected thereby. The natural knowledge which the Royal Society set out to improve has become one of the greatest influences of these times. The society and other bodies and individuals that have followed in its footsteps have, therefore, become possessed of certain most important opportunities, which are indeed duties. One of these is still, as it has always been, the encouragement of research, wisely conceived and well directed. A second is the preparation and presentment of the results of research, so that they can be sufficiently appreciated, and can be incorporated with

understanding into every activity, intellectual or physical, to which they apply. We are not, as discoverers, responsible for the uses that are made of our discoveries. We ought not to claim, in my opinion, to be given the direction of affairs in which our discoveries play a great part simply on account of that fact. But we are, at least, bound to see that our acquired knowledge is rightly stated so that it can be rightly used. We may also, as scientists, feel that we ought to help in putting knowledge to good use. This duty is actually discharged by numbers of men in these times.

It is curious to think that the feeling of responsibility is of recent growth. There was even a time when a discovery could be considered a private possession, to be withheld from general knowledge if thought fit. Newton, Hooke, Cavendish and many others were often in no hurry to give to the world what they had found; they were influenced by indifference, by fear sometimes, even by impish playfulness, as when truths were hidden in anagrams. They did not then look upon natural knowledge as an inheritance belonging to mankind, which when discovered ought to be shared.

Rumford, at the end of the eighteenth century, was one of the first to accept and proclaim his responsibility, and act upon it, when he tried to apply the laws of heat to the economy of fuel. His first attempt in London was made at the Foundling Hospital. The Royal Institution, in its first form, was his attempt to give concrete expression to his idea. The founders of the British Association were urged in their work by a similar motive and were to some extent under the belief that they were repairing a defect of the Royal Society. The vigorous action of the association in these days is a most commendable extension of its original purpose. The Royal Society undertakes a special part of the general responsibility. It is concerned with affording opportunities for the publication and discussion of original discovery, it also encourages discovery by the administration of funds entrusted to it for that purpose. And, of course, it represents officially the scientific activities of the nation, acting as an adviser on such matters in public affairs. In this field it has full opportunity for the exercise of all its powers. This limitation of service does not free the society from the need to attend always to the one great purpose, more fully realized of recent years, that of opening to mankind the new fields of natural knowledge. The new fields are not merely to be penetrated, they are also to be made public. There is, of course, a well-known saying that praises knowledge because it is useless. This cryptic statement would seem to be an ethical injunction to the researcher; it certainly does not mean that the most desirable knowledge is of no use to any one but the discoverer.

Even within the range of activities to which the Royal Society confines itself, in which contact with the general public is not often made, regard must be paid to the future exposition of discovery. Because the results of research have become so voluminous and so important, the manner of stating them, of arranging and storing them has also become important. We have to bear this in mind when we think of the arrangement on our shelves.

At the present time, the volumes of our *Proceedings* and *Transactions* have a certain resemblance to a building site on which the contributors of materials have shot their goods: and it must be said that the shooting is often done without regard to convenience of subsequent handling. He who would construct for himself a whole building finds it difficult to make use of the materials provided. Any one who has completed a piece of research and hopes that it may be accepted and published by the Royal Society or any society of learning is in the first place at pains to describe what he has done, the methods he has used and the inferences that he draws from his results. The manner of telling his tale will depend on the purpose he has in mind. He may think that he ought to set out his facts in full detail, so that any reader who is interested shall at least find all that he wants. If he is on the threshold of research work, he will often be influenced by the desire to prove his knowledge and ability; and may be led to make his tale long and complicated. It is very likely that he has not before him a mental picture of the man for whom he is writing; if he has, it is probably that of an expert, who is working in the same narrow region as himself, who knows all the technical terms and is familiar with the hidden difficulties of the subject (which, therefore, must be discussed in full), and will pick holes if he can. It is true that writing of this kind is of the highest value: expert must talk to expert.

Nevertheless, such writings make dull and difficult reading for the great majority of those who are interested in scientific discovery. How few there are who can critically study a paper of a certain type is only too well known to our secretaries and the chairmen of our sectional committees who must find referees to judge its merits, and to referees themselves who accept their often laborious task. When such papers are read at a meeting of the society, the paucity of the attendance and the lack of good discussion are obvious and distressing. In fact, it has been found well to take vast numbers of such papers as read, and even then the discussion of the few that are left is often disappointing.

It is on this account that greater stress has been laid recently on the provision of opportunities for organized discussions in which some important subject of recent development is considered by the workers in that

subject. The discussion ranges over a wider field than that of a single worker's account of his new discoveries. It is much more interesting and informing to the general body, as the very satisfactory attendances have shown. Clearly there is a desire to understand the main purpose and the principal achievements of each growing subject.

I believe that fellows, and others, have welcomed the recent plan of publishing summaries of papers as an appendix to the *Proceedings* as soon as the papers are received, publication of the papers themselves being deferred until approval has been given in the usual way. Not merely is an earlier announcement of discovery made on this plan, but the collection of summaries presents the general trend of research to those who are not specialists.

Summaries are the expression of a natural reaction to the difficulties caused by the growing specialization of research. They represent a certain recognition of the principle that discovery must be accompanied by exposition, the principle that has been little regarded in past years, but now demands acceptance.

The ideal summary is more than a mere digest or shortened form of the paper. It differs from the paper itself in that it is addressed to a wider circle of readers which may include the experts but contains also many others who should, in fact, receive the principal attention. For this reason it may be more difficult to write than the paper itself, because it must take into account the interests and the understandings of those who will rarely read the original paper, even if they could do so, but will gladly absorb the meaning and the information of the summary, especially if there is a connection with their own work. When the summary is written with this wider view it becomes literature, though the paper itself may be no more than a record.

Another reason for greater attention to the writing of summaries is that specialization quickly takes explorers out of sight of each other and out of sight of the main body. It is natural for them to talk to each other only and to forget every one else. Consequently, it becomes difficult to incorporate their work into any general scheme. Also it is dangerous for researchers to be so far out of reach. It is natural for them to lose a sense of proportion and to imagine, each one, that his is the main line, or at least a very important line of advance. Who is to call a halt when this happens, unless the work that is going on is so far appreciated that a general opinion can be formed as to its advisability? It would, of course, be impossible to put the direction of all research into the hands of an elected committee or a dictator. Yet a certain degree of control is required, and this is best exercised by general opinion reflected in the minds of those who direct in various ways the expenditure of money on research. The only way to facilitate the growth of a general opinion which is sound is to insist that a general account shall be given which is intelligible to a sufficient number.

These considerations tempt me to ask whether it is necessary that our *Transactions* and *Proceedings* should contain so much as they do at present. When a new departure in experiment or theory is made or a new fact is discovered or a new correlation, it is right that a careful and complete explanation should be given; and if this is not too long, it is excellent that it should appear in the *Proceedings*. If the novelty leads, as it often does, to a steady output of observation, extension, confirmation and illustration, with many figures and bulky tables, there must come a time when complete publication to the world becomes unnecessary and even tiresome. What the scientific world wants is a general account of progress made, so that its bearing may be clear. A mass of details in continuation is of interest to other workers engaged in the same research, but very few others want the full account. The *Proceedings* should contain papers of original discovery or fresh departure; as regards continuation papers, as they might be called, summaries properly written should be enough. Continuation papers should, of course, be preserved and at least be available on demand; still better, a few hundred full-sized photograph copies could be made. This could be done at a fraction of the cost of printing, especially if the printing is difficult, full of figures and symbols. The *Proceedings* would then be much reduced in size, and would be more handy, interesting and useful.

There is a further consideration of no small practical importance. A largely attended conference on documentation was held a few months ago at Oxford. The subjects with which it dealt were of comparatively modern importance, but were clearly of the greatest interest in a number of places, particularly in patent offices, and in the libraries of industrial research associations. The summaries of papers in scientific journals came in for much adverse comment, comment which seemed to be entirely just. The point was that summaries were written for the expert only and were often barely sufficient at that.

Finally, if the scientific worker is no longer to be content merely to observe and to record, but also to share his knowledge with the world in general, he needs certain qualifications and a certain education which are much less necessary in the more restricted field. He is dealing not only with facts but with men: his work enters the humanities. This is really a very great matter. It draws its importance from the tremendous consequences of the increase of the knowledge of nature which are now obvious. Lord Rayleigh has

lately shown the absurdity of the charge that scientific men are responsible for the evil uses that are sometimes made of their discoveries. But this responsibility is theirs, that they shall explain what they find so that their fellow-men know how they stand. The scientist can not be expected to see that discovery is rightly used, but no one except himself can rightly describe it. It is not to be expected that the best use will be made of what is imperfectly understood.

These are problems of tactics. They can not be fully solved while school and college still maintain an artificial division between two forms of teaching, naming one of them science and the other "humanities." They have far more in common than is generally recognized. There must, of course, be specialization, a divergence in the later stages. But the men of different types of mind must be kept together more than at present, so that when they meet in after-life they can understand each other. It happens too often now that the administrator makes mistakes because he can not understand his technician's advice, and the technician is incapable of expressing himself so that his administrator understands him. There ought not, in fact, to be a sharp distinction between the two. It is a fundamental point that humanities and science have joined hands in the service of mankind.

SUMMARY STATEMENT OF THE ACTIVITIES OF THE NATIONAL RESEARCH COUNCIL, 1937–1938

By Dr. ROSS G. HARRISON
PRESIDENT
and
ALBERT L. BARROWS
EXECUTIVE SECRETARY

Borderland Problems

Among new activities of the National Research Council during the year, 1937–1938, a number of undertakings reflect the consideration which has been given in the Council for several years to so-called "borderland problems." These problems lie on the fringe of interest of the traditional fields of the fundamental sciences or in between these fields. Perhaps they might better be called problems of the combined sciences, since it is frequently the contributions from several adjacent fields which are amalgamated into the solution of these problems. They seem to arise particularly at this time partly because of the rapidly expanding range of scientific interests and partly because of the necessary use of knowledge from several sources in order to meet the increasingly complex social and technological questions of the day.

In the life sciences, for instance, due to the discussion of problems of common interest in conferences of the preceding year and to suggestions from other sources, several new combination projects have been undertaken. Among these is a reorientation of previous concern of the Council in parasitology under a new Committee on Medical Problems Common to Animals and Man. Others relate to the genetics of pathogenic organisms; to problems of cellular physiology and the changes in organisms due to old age; to aerobiology; and to the bearing of the results of studies of experimental neuroses upon problems of neurotic behavior and other researches in psychiatry.

In the relationships between physical and earth sciences certain problems of geology have led to undertaking the preparation of a handbook of the physical and chemical constants of the materials with which geologists have to deal, and to the coordination of studies of the movement of water currents of different densities through reservoirs and lakes. The scrutiny, itself, of the field of geology in the light of its physical and chemical phases has led also to the definition of a considerable list of other geological problems.

Fellowships

A recently published list of the fellows of the Council for the past twenty years names 1,146 past and present fellows. Of these 263 (about 23 per cent.) carried on their fellowship work abroad or will do so. The total group was derived, with respect to undergraduate training, from some 260 educational institutions in the United States and Canada and from about twenty-five educational institutions abroad. The fellows have worked in about fifty universities and at many of the research institutions on this continent and at a large number of educational and research institutions abroad, mainly in European countries. Most of the past fellows are engaged in research work and over three fourths of the group are connected with research or educational institutions. For the current year 42 fellows are under appointment, selected last spring from 189 applicants. The fellowships are supported by funds provided by the Rockefeller Foundation.

Scientific Aids to Learning

In the spring of 1937 the Council appointed a Committee on Scientific Aids to Learning at the suggestion

of the Carnegie Corporation. The purpose of this committee is to aid in the adaptation for educational purposes of the scientific and technological advances of recent years in such fields, among others, as radio, motion pictures, sound recording and reproduction, photography including microphotography for documentary purposes, and improved forms of calculating machines for the analysis of data for special research uses. While these new developments in science and technology find their application to the learning process in many fields the committee is concerned primarily with the classroom at its various levels and with research work. It is because these scientific aids to learning are relatively new and their educational uses are largely unexplored that their characteristics, possibilities and limitations need to be carefully studied in order that the best advantage can be taken of their potentialities in the educational process.

The program of the committee includes a study of the cost of furnishing auditory aids in the classroom, a study of broadcast receivers for school use, a study of the actual use of broadcast programs in the schools of a number of cities, the preparation and testing of phonograph records as aids to teaching particularly in rural areas, a similar experiment with sound slide films, a study of school experience with motion picture projection equipment, a report on equipment and supplies for microphotography, the consideration of a program for testing eye fatigue in the reading of micro-film, and assistance in the development of a highly specialized machine for the solution of mathematical problems involved in certain psychological investigations. The funds for the support of these investigations are supplied by Carnegie Corporation. Special offices are maintained by the committee in New York City (41 East 42d Street).

Monographs in the Physical Sciences

For many years the Division of Physical Sciences of the Council has maintained a program of publication for monographs upon current research topics in the advancement of the physical sciences. These publications include a series of six monographs upon the physics of the earth, and single monographs upon such topics as the quantum theory, problems of acoustics, theories of magnetism, radioactivity, molecular spectra in gases, the scale of the universe, celestial mechanics, hydrodynamics, critical potentials, chemiluminescence, algebraic numbers and functions, and the numerical integration of differential equations. In addition to these treatises certain bibliographies and other aids to research in these fields have been produced.

These treatises have been prepared under the sponsorship of special committees and many of the treatises consist of contributions from several authorities upon various aspects of the subject discussed. Most of the monographs have been issued in the *Bulletin* series of the Council. Some have been published commercially. The expense of the editorial preparation and publication of these books was met in the earlier years from appropriations from the Rockefeller Foundation. Later the Council added funds for this purpose and a considerable sum is still on hand accumulated from the sale of these *Bulletins*, which is to be used as a rotating fund for the publication of later monographs of this nature. Four of the books were published through a special revolving fund set up for the printing of mathematical books. For two of the monographs in the general series second editions have been issued, two others have been reprinted, and two have been translated into European languages. Altogether some 43 volumes have been issued in these ways. During the past year the seventh member of the series upon the physics of the earth, "Internal Constitution of the Earth," was completed, and this monograph is now in press. Several other monographs are also in preparation.

Highway Research

The work of the Highway Research Board in cooperation with the U. S. Bureau of Public Roads has been continued in accordance with its former program for coordinating information and encouraging investigations upon the planning, building and operation of highways. The seventeenth annual meeting of the board was held in Washington, D. C., on November 30 and December 1–3, 1937, with an attendance of about 475. Selected papers presented at this meeting have recently been published in a volume of *Proceedings* of some 534 pages, with a supplement upon "Soil-Cement Mixtures for Roads." The Board also issues a monthly serial, *Highway Research Abstracts* (in mimeographed form).

During the past year at the special request of the Bureau of Public Roads the board has devoted particular attention to the problem of highway safety. These studies have been carried on in cooperation with the highway organizations in a number of the states. The results of the studies were made the basis of the following series of reports presented to Congress by the bureau last spring:

Part 1: Non-uniformity of State-Motor-Vehicle Traffic Laws.
Part 2: Skilled Investigation at the Scene of the Accident Needed to Develop Causes.
Part 3. Inadequacy of State-Motor-Vehicle Accident Reporting.
Part 4: Official Inspection of Vehicles.
Part 5: Case Histories of Fatal Highway Accidents.
Part 6: The Accident-Prone Driver.

Among recommendations in these reports attention

was called to the need for (1) greater uniformity in motor vehicle traffic laws, (2) standardized methods of reporting highway accidents, (3) improved inspection services for cars, and (4) the expansion of highway patrol organizations. The studies have disclosed that our present knowledge of how and why highway accidents occur is wholly inadequate for a successful study of the problem of highway safety, especially with respect to the habits, capabilities and limitations of automobile drivers. These studies are being continued during the current year with special attention to (1) methods of testing drivers for proneness to accident, (2) speed control on rural highways, and (3) the analysis of case histories of fatal accidents.

In addition to the work of the Highway Research Board the Committee on the Psychology of the Highway of the Council's Division of Anthropology and Psychology has formulated a program of investigations upon (1) the drinking driver in relation to licensing authorities, (2) the effects of fatigue on driving performance and its relation to hours of labor, and (3) problems of headlight illumination.

Industrial Research Institute

It is hardly more than fifty years since the first research laboratory was established by an industrial firm in the United States. The great development, however, of the industrial laboratory has taken place within the last twenty years, and at present there are well over 1,700 such laboratories in this country. Aside from technological matters, these laboratories have many problems of organization and management in common arising from the urge for making the industrial research unit render its maximum effectiveness to the concern of which it is a part, and for making the best use of the results of research work. While in industry the ultimate test is efficiency, the verdict as to what constitutes efficiency often depends upon how far to look ahead.

In order to provide a medium in which directors of research laboratories might study cooperatively these problems which are alike in many establishments, the Division of Engineering and Industrial Research organized last spring an Industrial Research Institute. This is a self-sustaining organization, under the auspices, at present, of this division of the Council. Its purpose is to provide coordinated facilities for examining common problems and for the compilation of information relating to industrial research developments and to the organization of research agencies in industry. Among the questions to which this institute will give attention are problems of research personnel and its working conditions as distinguished from production personnel, the selection and training of research men, laboratory construction and management, the keeping of research records, planning research budgets as separate from manufacturing budgets, means for keeping informed upon current progress in industry, and cooperation with universities and other research institutions. The institute is to hold several meetings a year. It carries on its studies in part through committees of its own membership and in part through special investigators.

Reproduction of Records

The work on the reproduction of records, which is being conducted at the National Bureau of Standards in cooperation with an Advisory Committee of the Council, grew out of earlier investigations at the bureau upon the preservation of papers. This work has been turned during the past three years to studies of the durability of photographic film which is coming into increasing use for record purposes. Certain of these investigations have been devoted to the comparison of the usual emulsion-coated acetate film with a Cellophane-base film containing a light-sensitive dye for formation of the record image within the film. Other studies have covered the aging effects of light on film, preservatives and protective treatments to prevent scratching, favorable conditions for the storage of film, methods of testing the condition of old film, shrinkage and expansion of film and paper, especially that used in aërial photography, means for more completely removing hypo in the processing of film and a study of the effects of a small quantity of unstable cellulose nitrate usually present in the slow-burning or safety type of acetate film. The next stages of the work will be to arrange for the confirmation of findings recently obtained in testing the resolving characteristics of various types of film, to carry these resolution tests further by using a number of available commercial devices and to plan tests for the characteristics of commercial apparatus for photographing documents.

The investigations upon the preservation of paper were supported by the Carnegie Corporation cooperatively with the bureau, as were also the earlier stages of work upon record film. These studies for the past year, however, have been supported by contributions from the film and apparatus industry.

(To be concluded)

OBITUARY

MALCOLM LYONS

Malcolm Lyons, instructor in animal industry of the University of Arkansas, was accidentally shot while hunting on Thanksgiving Day (November 24, 1938), thus ending a most promising scientific career. Although only 27 years of age, Lyons had published a

number of excellent scientific papers in such journals as SCIENCE, *Journal of Nutrition, Poultry Science* and the Experiment Station bulletin series of the Kentucky and Arkansas Stations.

Lyons possessed a keen analytical mind and a deep devotion to research. Although teaching ten hours a week at the time of his death, the head of his department stated that he was actually conducting more research than many other men with no teaching duties to distract them. He worshipped truth and detested inaccuracy and error. He conquered the obstacles that were in his way and forged on toward the goal he had set for himself. He was thorough, energetic, conscientious and dependable. He set a splendid example for his colleagues and students which was a constant challenge to them to serve science with the same loyalty he had shown.

Lyons graduated from the University of Kentucky in 1932 with the degree of B.S. in Agriculture. In 1934 he received his M.S. at Iowa State College, where he served as research fellow in animal nutrition. He served the Kentucky Experiment Station as research assistant for more than two years and the Arkansas Station for a year and a half. In the 1938 summer-term he completed the residence and course requirements at Iowa for the doctor's degree, which he would have received during the present academic year after writing his thesis, the experimental work for which had been completed.

Lyons was greatly admired by all who knew him, and he leaves a host of friends who share the loss with his bereaved family. He is survived by his wife, an eighteen-months-old daughter, his parents and two sisters.

J. HOLMES MARTIN

UNIVERSITY OF KENTUCKY

YNES MEXIA

YNES MEXIA'S death on July 12, in Berkeley, California, closed a career as a botanical collector of note. Born in Washington, D. C., May 24, 1870, during the residence of her father, General Enrique A. Mexia, there on official status from Mexico, she spent the early half of her life in the United States and Mexico, making San Francisco her home for the last thirty years. Always interested in plants, she began actively collecting in 1922 in Mexico. She usually went to remote places, however difficult to reach, the Pongo de Manseriche by raft and canoe, eastern Ecuador by pack oxen, eastern Oaxaca afoot. She prepared her specimens carefully and gave abundant notes. She collected approximately 9,300 numbers, from 140,000 to 150,000 specimens and over 500 new species, the last collection being yet unidentified. Many new species and one new genus were named in her honor.

A list of her expeditions with approximate numbers follows: 1922 Mexico; 1925 Mexico, 500 numbers, 3,500 specimens; 1926–27 Mexico, 1,600 and 33,000; 1928 Alaska, 365 and 6,100; 1929 Mexico, 315 and 5,000; 1929–32 Brazil-Peru, 3,200 and 65,000; 1934–37 South America from Ecuador to Tierra del Fuego, 2,200 and 19,900; 1937–38 Mexico, 700 and 13,000.

The most complete set of her plants is in the herbarium of the University of California; also complete records of her trips and collections.

N. FLOY BRACELIN

RECENT DEATHS AND MEMORIALS

WILLIAM BAKER DAY, since 1919 dean of the College of Pharmacy of the University of Illinois, died on December 10. He was sixty-seven years old.

DR. GEORGE VAN NESS DEARBORN, chief of the Department of Medical Psychology of the U. S. Veterans Administration, has died at the age of sixty-nine years.

DR. JOSEPH A. HILL, for more than forty years a statistician with the Bureau of the Census, died on December 12. He was seventy-eight years old.

A CORRESPONDENT writes: "News has been received of the death at the age of thirty-one years of L. G. Schnirelman, professor of mathematics at the University of Moscow and a member of the Mathematical Institute of the Academy of Sciences of the U.S.S.R. Schnirelman had made first-rate contributions in widely separated branches of mathematics (topology, the calculus of variations, number theory). No branch of science has reached a higher distinction in the U.S.S.R. than mathematics, and the deceased was one of its strongest and most original mathematicians."

THE U. S. Board on Geographical Names has named a mountain 9,900 feet high in Yellowstone National Park Mount Hornaday in honor of the late Dr. William T. Hornaday, until his retirement in 1926 director of the New York Zoological Park. Mount Hornaday is on the divide at the head of Plateau Creek and is visible from the northeast park entrance road.

SCIENTIFIC EVENTS

THE PROPOSED CANCER SERVICE IN GREAT BRITAIN

A BILL embodying a new plan for securing earlier and more effective treatment of cancer involving the establishment of a cancer service which will make the best modern facilities for diagnosis and treatment available in every part of the country has been formally introduced in the British House of Commons.

According to the London *Times* the government has decided to place on county and county borough coun-

cils, either singly or in regional groups, the duty of securing adequate facilities for the diagnosis and treatment of persons suffering, or suspected to be suffering, from cancer. It is estimated that at present only one case in four which might hopefully be treated by modern methods is so treated.

These major local authorities will be required to submit their arrangements for the minister's approval within a reasonable time. Before doing so they will consult the Radium Commission and representatives of the voluntary hospitals and the medical practitioners in each locality. It is proposed to have diagnostic centers at which expert clinical advice on a team basis will be available to all. In general these centers will be in the large towns, and patients will come to them from the surrounding areas. Facilities for treatment will be provided in voluntary hospitals, whose services it is hoped to utilize to the utmost, or in hospitals under the control of local authorities. The government intends to bring the most modern methods of treatment, whether by surgery, radium or deep x-rays —alone or in combination—within the reach of every sufferer. This will mean the provision of additional facilities for treatment at appropriate local centers, both by developing existing centers and providing new ones.

It is estimated that when the service is in full operation the total additional expenditure will amount to about £600,000 a year for England and Wales and £100,000 for Scotland. In meeting this expenditure local authorities will be assisted by exchequer grants which will be approximately equivalent to 50 per cent. of the additional cost incurred. But the grant will be made according to the "weighted population" formula, and the 50 per cent. will be scaled up or down according to the needs of the area. In some of the poorest areas the exchequer grant will amount to 80 per cent. It will probably take four or five years before the cost of the service reaches £700,000 a year. At first there may be some scarcity of the skilled workers needed.

The bill enables the Minister to lend up to £500,000 to the National Radium Trust for the purchase of radium and other radio-active substances and of equipment for radio-therapeutic treatment. The trust has already arranged an option for a substantial purchase of radium from Canada at a fixed price over the next five years. The bill will prohibit the dissemination of advertisements for "cancer cures" to the lay public.

COMMITTEE OF THE BRITISH ASSOCIATION ON THE SOCIAL RELATIONS OF SCIENCE

As has been stated in SCIENCE, at the recent meeting in Cambridge of the British Association for the Advancement of Science, there was formed a committee on the Division for the Social and International Relations of Science. The committee, under the chairmanship of Sir Richard Gregory, includes the president and general officers of the association *ex officio* and

Sir Daniel Hall, Sir Frederick Gowland Hopkins, Sir John Russell and Lord Stamp (*vice-chairmen*), Professor F. C. Bartlett, Professor J. D. Bernal, Professor P. M. S. Blackett, Mr. Ritchie Calder, Mr. A. M. Carr-Saunders, Professor S. Chapman, Dr. C. H. Desch, Professor A. C. G. Egerton, Professor H. J. Fleure, Mr. E. W. Gilbert, Professor N. F. Hall, Mr. R. F. Harrod, Professor A. V. Hill, Sir Clement Hindley, Professor L. Hogben, Dr. L. E. C. Hughes, Dr. J. S. Huxley, Mr. D. Caradog Jones, Professor H. Levy, Dr. C. S. Myers, Mr. Max Nicholson, Sir John Orr, Professor J. C. Philip, Professor J. G. Smith, Professor R. G. Stapledon, Professor F. J. M. Stratton, Professor F. E. Weiss, Mr. H. G. Wells, Mr. J. S. Wilson and Dr. S. Zuckerman.

The London *Times* states that a circular has been prepared for issue to institutions at home and abroad, indicating the main purposes of the division as "the objective study of the effects of advances in science on communities, and reciprocally the effects of social conditions upon the progress of science; and the encouragement of the application of science to promote the well-being of society." The committee is empowered to arrange meetings of the division, to coordinate work dealing with the social relations of science, both at home and abroad, to be prepared to act in a consultative capacity and to supply information to organizations, individuals and the public, to initiate and carry out inquiries and research and to secure their publication.

Two of the most important functions of the division will be to coordinate the large amount of work which has already been done or undertaken by numerous existing organizations, and to make the best use of the association's platform to bring the results of such work before the public. It is hoped to cooperate with the International Council of Scientific Unions, which has already set up a Committee on Science and its Social Relations with a view to preparing a report of world-wide scope.

BIOLOGICAL ABSTRACTS

A RECENT issue of SCIENCE[1] contained the announcement of the 1939 publication plan for *Biological Abstracts*. Under this plan there is to be a breakdown into five parts according to subject-matter, ranging in cost from $4.00 to $9.00, with $25.00 the charge for all parts brought under one cover.

During the next year, as during the current one, it is hoped that societies will continue their contribution of $2.00 a member toward the support of *Biological Abstracts*. It is highly desirable that this support be given during the transition period to the new plan, which has won well-nigh universal approval. For the present year five societies took such action, while sev-

[1] SCIENCE, 88: 294, 1938.

eral others approved a request for voluntary pledges by their membership. All such contributions will be counted toward the subscription price of a section or the total edition, and no contributor is expected to make more than one such donation even though a member of more than one contributing society.

For the year 1938 such contributors have the option of either receiving the index to volume 12 or of deducting $2.00 from their personal subscription to that volume (provided their institution now subscribes). The same privilege is accorded to the contributors of past years; that is to say, a 1936 contributor, for example, can have his contribution applied to the purchase of volume 10.

Now that 1938 nears an end, it is desirable that each contributor inform the Business Manager of *Biological Abstracts* at the University of Pennsylvania what option he selects.

The Board of Trustees wishes to express its appreciation to the members of the five societies which have voted contributions this year:

American Physiological Society
American Society of Naturalists
American Society of Zoologists
Ecological Society of America
Genetics Society of America

as well as to those individuals of other societies who made a voluntary contribution or outright donation.

The Board of Trustees of *Biological Abstracts* consists of G. S. Avery, Jr., H. P. Barss, A. F. Blakeslee, P. R. Burkholder, A. J. Carlson, A. B. Dawson, H. B. Goodrich, A. P. Hitchens, D. D. Irish, M. L. Raney and G. W. Hunter, III, *President*.

INTERNATIONAL CONTEST OF THE SCIENTIFIC APPARATUS MAKERS OF AMERICA

ENGINEERS representing all industries, from every section of the United States and three foreign countries, sent in entries to the First Instrumentation Contest sponsored by the Industrial Instruments Section of the Scientific Apparatus Makers of America and conducted by Richard Rimbach, publisher of *Instruments* (the magazine of measurement and control). The contest closed on November 15 and the judging was held on December 6 at the Hotel Commodore, New York City.

Prizes were awarded as follows:

First Prize $200.—F. K. Vial, vice-president in charge of research, Association of Manufacturers of Chilled Car Wheels, Chicago, "Automatic CO_2 Compensator for Cupola Control."

Second Prize $100.—R. K. Hellmann, electrical engineer, Transatlantic Research, Inc., New York City, "An Audio Frequency Spectrometer."

Third Prize $50.—Wilton E. Stackhouse, technician, United Gas Improvement Company, Philadelphia, "A Hydrogen Sulphide Recorder."

Fourth Prizes $25 each.—George B. Bailey, president, Thermal Engineering Company, Boston, "Automatic Control Applied to the Diesel Engine"; H. A. Kleinman, engineer, United Power Manufacturing Company, Moline, "Application of a Multi-Pointer Gage for Speed Measurement"; M. G. Mastin, chemical engineer, Westvaco Chlorine Products Corporation, South Charleston, "A Sensitive Method of Flow Control"; Walter E. Smith, technologist, C. Brewer and Company, Ltd., Honolulu, "Sugar Boiling by Instrument Control."

Fifth Prizes $10 each.—Sherman Chase, steam engineer, Carnegie-Illinois Steel Corporation, South Chicago, "Relative Volumetric Gas Analysis by Cascaded Absorption and Oxidation Recorded by a Pressure Recorder"; Harry C. Gray, stress analyst, Wright Aeronautical Corporation, Paterson, N. J., "Sound Frequency Measurement"; G. J. Gross, transmission engineer, Pennsylvania Water and Power Company, Baltimore, "Ground Megger Signal Generator in Locating Buried Conductors"; Wm. B. Hess, test engineer, Safe Harbor Water Power Corporation, Conestoga, Pa., "The Steam Engine Indicator Differential Pressure Gage"; Charles Wasserman, technological assistant, Consolidated Gas, Electric Light and Power Company, Baltimore, "An Unusual Application of a General Electric Torque Balance Watt-Telemeter."

GRANTS-IN-AID FOR STUDIES IN SCIENCE INSTRUCTION

THE second meeting of the Committee for the Improvement of Science in General Education[1] of the American Association for the Advancement of Science was held in Chicago on December 3 and 4. A partial statement of the agenda upon which the committee worked will appear later. One of its responsibilities is assuming proportions which seem to warrant this separate statement.

It will be recalled that among other things the committee was charged with the following task. "To obtain and to use financial support for such work in the sciences as gives promise of being effective in improving the teaching of science in general education." At the Chicago meeting the committee considered the reception and preliminary evaluation of experimental projects on teaching of the sciences at college and university level. In all such cases the appropriations requested are likely to exceed the funds that are available for such purposes, a situation which will evidently develop in this case also. Nevertheless, the committee invites correspondence from teachers of science who have teaching experiments under way or seriously con-

[1] SCIENCE, 87: 454, 1938.

templated, which would be facilitated by grants-in-aid. Naturally, any one requesting such grants will expect to defend their necessity or appropriateness and to furnish evidence that the conditions under which the proposed experiments are to be performed are favorable to their advantageous prosecution.

The preliminary "blueprint" of the field that may be covered to advantage by a series of experiments in the teaching of the sciences will be completed by June 30. Projects to be considered must be in hand not later than May 20. Correspondence may be initiated with any member of the committee. There will be some advantage in selecting one of the members whose field of professional competence includes that within which the proposed project falls.

The fact should be borne in mind that only projects designed to improve the teaching of science in general education are to be submitted. Improvement in preparation of "majors" in the various sciences or, in general, the strengthening of specialist education is outside the purview of this committee.

The members of the committee, grouped by subjects, are as follows:

Botany: Professor H. C. Sampson, the Ohio State University; Professor P. B. Sears, Oberlin College, Oberlin, Ohio.

Chemistry: Professor C. C. Furnas, Yale University; Professor N. E. Gordon, Central College, Fayette, Mo.; Professor W. C. Johnson, University of Chicago; Professor O. M. Smith, Agricultural and Mechanical College, Stillwater, Okla.

Education: Professor H. J. Arnold, Columbia University; Professor R. W. Tyler, University of Chicago.

Geography and Geology: Professor Carey Croneis, University of Chicago; Professor Kirtley Mather, Harvard University.

Mathematics: Professor J. S. Georges, Wright Junior College, Chicago; Professor E. R. Hedrick, University of California at Los Angeles.

Physics: Professor C. J. Lapp, State University of Iowa; Professor L. W. Taylor (*chairman* of committee), Oberlin College.

Zoology and Biology: Professor Bert Cunningham, Duke University; Professor M. F. Guyer, University of Wisconsin; Professor A. C. Kinsey, Indiana University.

THE WASHINGTON MEETING OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

CHESTER R. LONGWELL, chairman of the Committee on Coordinated Interests of Yale University, reports that as one step in the arrangements for the approaching assembly of the International Union of Geodesy and Geophysics in this country, the following letter has been sent to more than two hundred institutions and organizations, including universities, colleges, research institutions, Federal and state scientific bureaus and commercial corporations. The letter is printed here with the thought of extending the invitation to other organizations and individuals who may be interested but have not been reached directly by the letter, which reads:

No international scientific association covers a broader field of interest than the Union of Geodesy and Geophysics. The union is made up of seven constituent associations, devoted to geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, volcanology and hydrology. Physicists, geologists, geographers, astronomers and many types of engineers, in addition to specialists representing the particular fields suggested in names of the associations, find a common meeting ground in the union, which owes its origin and its continued growth to the interlocking problems crossing the borders of the several physical sciences in all the countries. The meetings of the union, held at three-year intervals, not only promote international cooperation in scientific enterprises but also help materially to foster international good will.

The International Union of Geodesy and Geophysics will meet in Washington, D. C., September 4 to 15, 1939. Official host for the meeting will be the American Geophysical Union, in cooperation with the National Research Council. The twelve days of the Washington session will be occupied with assemblies of the union as a whole, meetings of the constituent associations and receptions. Before the session there will be three organized trips to various parts of the country. It is expected that a large number of foreign delegates will attend the session, representing the member countries, of which there are 36 besides the United States. Probably there will be an especially large attendance from all sections of this country, representing not only the Geophysical Union but also numerous scientific and educational institutions.

Professor Longwell writes:

Practically every institution in this country that supports physical science in any form has a logical interest in the Washington meetings of next year. The American Geophysical Union urges that you join as far as possible in playing host to our fellow scientists from other countries in making the session successful. In particular, we shall be happy if you will discuss this matter with individual scientists and departments of science in your institution, and name one or more delegates to represent your institution at the meetings of the union next September. We suggest that as far as possible the delegates selected be men who are actively interested in some aspects of geophysics, since such men will gain most from and contribute most to the meetings. It should be added that travel and other expenses of delegates will have to be borne by the individuals or by the institutions they represent, because the union does not have any funds for this purpose.

Information about the union and its constituent associations appeared in an article by N. H. Heck on the International Union of Geodesy and Geophysics in SCIENCE, April 22, 1938. Circulars giving detailed information concerning the coming meeting will be sent to any one on request.

SCIENTIFIC NOTES AND NEWS

THE doctorate of science of the University of Oxford was conferred on December 10 on Dr. Irving Langmuir, associate director of the research laboratories of the General Electric Company at Schenectady, N. Y. Dr. Langmuir delivered on December 8 the first lecture at the Royal Institution, London, under the plan sponsored by the Pilgrim Trust for interchange of lecturers between the Royal Society and the National Academy of Sciences in Washington. His subject was "Molecular Films." Sir William Bragg, president of the Royal Society, will deliver the first lecture to be given in America on April 24 at the annual meeting of the National Academy of Sciences in Washington.

A. CRESSY MORRISON was reelected to the presidency of the New York Academy of Sciences at the annual dinner meeting on December 14. Honorary fellowships were conferred on Professor Edwin G. Conklin, of Princeton University, executive vice-president of the American Philosophical Society; on Dr. Ross Granville Harrison, of Yale University, chairman of the National Research Council, and on Dr. Irving Langmuir, of the General Electric Company. Eighteen scientific men were elected fellows. Other officers elected were: *Vice-presidents,* Ida H. Ogilvie, Robert T. Rock, Jr., Horace E. Wood, 2d, Harry L. Shapiro and Duncan A. MacInnes; *Recording Secretary,* Frederick H. Pough; *Corresponding Secretary,* Roy Waldo Miner; *Treasurer,* Wyllys Rosseter Betts; *Librarian,* John Hendley Barnhart; *Editor,* Erich M. Schlaikjer; *Councilors,* W. Reid Blair and G. Kingsley Noble; *Finance Committee,* Herbert F. Schwarz, John D. Sherman, Jr., and Wayne M. Faunce. The speakers were Professor Victor K. LeMer, of Columbia University, who discussed the velocity of chemical reactions, and Dr. Roy Waldo Miner, curator of living invertebrates at the American Museum of Natural History, who described his expedition to the South Seas in 1936 to study pearl shell.

AT the annual meeting of the New England Water Works Association, J. R. Baylis, physical chemist of Chicago, was awarded the Dexter Brackett Memorial Medal "in recognition of his outstanding work in water purification."

DR. HANS A. BETHE, professor of physics at Cornell University, was presented with the Morrison Prize of $500 at the annual dinner meeting of the New York Academy of Sciences and affiliated societies "for the best paper on solar and stellar energy" entitled "Energy Production in Stars." Winners of two other Morrison prizes of $200 each were Dr. F. Gaynor Evans, of the University of New Hampshire, for his paper on "The Morphology and Functional Evolution of the Atlas-Axis Complex from Fish to Mammals," and Dr. Norwood C. Thornton, of the Boyce Thompson Institute, Yonkers, N. Y., for his paper on "Oxygen Regulates the Dormancy in the Potato." Funds for the prizes were provided by A. Cressy Morrison, president of the academy.

AT the annual general meeting of the London Mathematical Society its De Morgan Medal was presented to Professor J. E. Littlewood, "for his contributions to mathematical knowledge."

PROFESSOR FRANK B. ROWLEY, director of the Engineering Experiment Laboratories of the Institute of Technology of the University of Minnesota, a former president of the American Society of Heating and Ventilating Engineers, has been awarded the F. Paul Anderson Medal of the society, which will be presented to him at a meeting in Pittsburgh in January.

IN recognition of his "distinguished services, particularly in connection with the current construction of the 392-mile Colorado River Aqueduct," F. E. Weymouth, general manager and chief engineer of the Metropolitan Water District of southern California, has been elected an honorary member of the American Society of Civil Engineers.

AT a recent meeting of microbiologists at the Pasteur Institute of Paris, Professor Martin, director of the institute, conferred the insignia of the grand cross of the Legion of Honor on behalf of the French Government on Professor Jules Bordet, director of the Pasteur Institute of Brussels, in recognition of his work on immunology.

DR. W. K. HATT, research professor of Purdue University, will retire on January 1 with the title of emeritus professor of civil engineering after forty-five years of service. Following a short period of travel to Australia he will maintain residence at Purdue University.

WORD has reached this country that the editor of the *Zentralblatt für Mathematik und ihre Grenzgebiete,* Professor Otto Neugebauer, now of Copenhagen, has resigned. The resignation from this mathematical abstracts journal was occasioned by the action of the publisher, Julius Springer, of Berlin, in dropping Professor Levi-Civita, of Italy, from the board without the knowledge of the editor, as well as by the demand that the editor give assurance that no emigrants would be allowed to referee articles by German authors. In consequence of this interference with editorial policies, the associated editors resident in America, Professors Courant, Tamarkin and Veblen, have tendered their

resignations, as have also a number of associate editors and collaborators in other countries.

LIEUTENANT COMMANDER FRANCIS W. REICHELDERFER has been appointed acting chief of the U. S. Weather Bureau, succeeding Dr. Willis R. Gregg, who died last September. Commander Reichelderfer had charge of reorganizing and developing the Naval Meteorological Service. In 1928 he was assigned to the Naval Air Station at Lakehurst, N. J., and later served as meteorologist on several flights and expeditions.

DR. ROSS T. MCINTIRE, for the last five years White House physician, has been appointed surgeon general of the Navy with the rank of rear admiral. He has held since June, 1934, permanent rank of commander, and was appointed medical inspector with the rank of captain in 1935, to remain in effect during his assignment as physician at the White House.

DR. ROBERT A. BLACK, professor of pediatrics, Loyola University School of Medicine, has been appointed president of the Chicago Board of Health. He will fill this position during the absence of Dr. Herman N. Bundesen, who has been granted leave pending the outcome of the government's anti-trust action against the milk industry.

DR. H. L. TIDY has been elected dean of the Medical School, St. Thomas's Hospital, London, in place of the late Professor Leonard S. Dudgeon.

DR. EARL D. BOND, director of the Institute for Mental Hygiene and head of the department of nervous diseases of the Pennsylvania Hospital, has resigned to devote his time to research. He will be succeeded by Dr. Lauren H. Smith, a member of the executive staff of both units since 1926. Dr. Bond will continue as vice-dean for psychiatry and professor of psychiatry at the University of Pennsylvania Graduate School of Medicine.

N. F. WATERS, of the department of poultry husbandry at the Iowa State College, has resigned, to become senior geneticist at the regional laboratory for poultry research in East Lansing, Mich.

DR. JAMES B. MURPHY, chief of the Cancer Research Division of the Rockefeller Institute for Medical Research, New York, and Dr. Mont R. Reid, director of surgical service of the Cincinnati General Hospital and professor of surgery at the University of Cincinnati, have been appointed members for three-year terms of the National Advisory Cancer Council. They succeed Dr. Francis C. Wood, director of the Crocker Institute of Cancer Research of Columbia University, and Dr. James Ewing, director of the Memorial Hospital, New York, both of whom were named as original members of the council in 1937. Other members of the council are: President James B. Conant, of Harvard University; Dr. Arthur H. Compton, of the University of Chicago; Dr. C. C. Little, managing director of the American Society for the Control of Cancer, and Dr. Ludvig Hektoen, emeritus professor of pathology of the University of Chicago.

THE Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships of the value of £300 for the year 1938–39: Dr. Vernon Hollis Booth, a British fellowship, tenable for two years, at the University of Cambridge; Donald McNeil, a Glasgow fellowship, tenable for two years, at the University of Glasgow; Dr. Alfred G. Epprecht, a Swiss fellowship, tenable for one year, at the Imperial College of Science and Technology, London. The trustees have renewed the following fellowships for a second year: Dr. A. E. Alexander (British fellow), at the University of Cambridge; Dr. E. de Salas (Spanish fellow), at University College, London; Dr. J. J. Hermans (Netherland fellow), at University College, London; M. Jean Monvoisin (French fellow), at the Royal Institution, London; Hazime Oosaka (Japanese fellow), at University College, London.

DR. HARLOW SHAPLEY, director of the Harvard Observatory, has recently returned from a trip of inspection to the Boyden Station of the observatory in Bloemfontein, South Africa. After attending the meeting of the International Astronomical Union in Stockholm early in August, Dr. Shapley went to England, where he was one of the invited speakers at the Cambridge meeting of the British Association. From London he flew to South Africa. After a stay of five weeks at Harvard Kopje, he returned by boat. While in South Africa he gave addresses to the Witwatersrand University in Johannesburg, University College of Orange Free State in Bloemfontein, and the South African Association for the Advancement of Science.

RUDYERD BOULTON, curator of birds at the Field Museum, Chicago, during November conducted field work in southern Mississippi, near Ocean Springs. At the invitation of Messrs. James R. Leavell and Carl A. Birdsall, of Chicago, owners of a large tract of wilderness land in this region, he participated in a preliminary natural history survey to determine the possibilities for conservation projects and special zoological studies.

DR. DORA ILSE, who has been working for the past two years in the laboratory of Dr. Imms, at the University of Cambridge, lectured at the University of Colorado on December 3, on the reactions of butterflies and bees to colors. The lecture was illustrated by moving pictures. Dr. Ilse has also lectured at various other American universities, including Cornell, Illinois,

Minnesota, Kansas, California, and at the American Museum of Natural History.

DR. J. W. BEAMS, professor of physics at the University of Virginia, delivered a lecture on "High-Speed Centrifuging" before the Franklin Institute, Philadelphia, on the evening of December 15.

SIR EDWARD MELLANBY, of Emmanuel College, Cambridge, Fullerian professor of physiology in the Royal Institution and secretary of the Medical Research Council, has been appointed Rede lecturer for the year 1939.

A GRADUATE course on electron optics and electron microscopy will be offered by the department of physics of the University of Pennsylvania during the second semester. The course will be given by Dr. L. Marton, lecturer in physics at the university and associate of the RCA Manufacturing Company, together with Drs. G. A. Morton and E. G. Ramberg, of the Electronics Research Division of the company. The lectures will be given on Wednesday afternoons from five to six P.M., in the Randal Morgan Laboratory of Physics.

RECENT lecturers before the department of geology and geography, Northwestern University, were: Dr. W. H. Voskuil, mineral economist, Illinois Geological Survey, on "Economics of Mineral Production"; Dr. Clyde P. Ross, geologist, U. S. Geological Survey, on "Cinnabar Deposits of California"; Dr. Helen M. Strong, soil conservationist, U. S. Department of Agriculture, on "Soil Conservation Methods"; Dr. D. F. Hewett, geologist, U. S. Geological Survey, on "Mining Geology in the Western United States"; Professor Clarence F. Jones, School of Geography, Clark University, on "South America, from the Caribbean to the Argentine"; Dr. Benjamin B. Cox, Vacuum Oil Company, on "Modern Petroleum Development"; Professor J. H. Maxson, California Institute of Technology, on "Geological Studies in the Grand Canyon of the Colorado"; Dr. Harold T. Stearns, U. S. Geological Survey, Hawaii, on "Hawaiian Volcanoes"; Dr. Takeo Watanabe, University of Sapporo, Japan, on "Japanese Geological Institutes"; and Professor G. W. White, University of New Hampshire, on "Novya Zemlya."

THE Eastern railroads have announced a reduction in rates from December 15 to January 10 with the usual stop-over privileges for those expecting to attend the meeting of the American Association for the Advancement of Science in Richmond, Virginia, from December 27 to 31. Round-trip railway coach fares will be reduced by 20 per cent., to two cents per mile. Pullman fares will be reduced by 10 per cent. to 2.7 cents per mile.

THE Western Chemical Congress will meet in August, 1939, during the Golden Gate International Exposition. A number of societies, associations and industrial corporations are interested in planning for the congress and are cooperating with a committee of technologists on the Pacific Coast. The major theme is stated as "The Place of Chemistry in Modern Life," and it has the object to foster advancement of chemical knowledge and development of chemical process industries in the West. Facilities are to be arranged for separate meetings of the various societies and associations participating.

IT is announced that the new electroencephalographic laboratories of the Montreal Neurological Institute will be opened during the first week of January. The work to be done in these laboratories has been made possible by a grant from the Rockefeller Foundation to promote research in epilepsy and dementia. Funds contributed by a group of Montrealers, who have been interested in the institute since its inception, provided for the building of an extension necessary for this work. Since the opening of the institute in September, 1934, extensive researches in epilepsy have been carried out under the direction of Dr. Wilder Penfield, director of the institute and professor of neurology and neuro-surgery at McGill University. The electroencephalographic laboratories will be under the direction of Herbert H. Jasper, Ph.D. (Iowa), D. ès Sci. (Paris). Dr. Jasper, after post-graduate work in Iowa and Oregon, studied for two years at the Sorbonne. Previous to going to Montreal he was assistant professor of psychology at Brown University and director of the Neurophysiological Laboratories and the Psychological Clinic at Bradley Hospital, Providence, R. I.

A STATUTE was promulgated on November 1 at the University of Oxford, establishing the Edward Grey Institute of Field Ornithology and providing accommodation for it at 39, Museum Road. Its functions will be to carry out research into problems of ornithology with special reference to the numbers, distribution, movements, habits and economic status of British birds, to collect, coordinate and supply information on these subjects obtained from published sources and from field observers, and to publish the results of its work by means of printed papers, informal instruction or lectures.

COURSES in television have recently been planned by the Radio Corporation of America. For those who have had no previous training in radio engineering the course requires a period of two years in the day school or five years in the evening school. Special Television Units of six months duration in the day school or of one year in the evening school are available to applicants possessing adequate technical background.

DISCUSSION

MULTIPLE STROKES IN LIGHTNING

THE recent interesting note by H. L. Dean on "Stroboscopic Illusions caused by Lightning"[1] prompts me to report a somewhat similar series of observations, which also included an impromptu measurement of the average interval between successive discharges in a multiple stroke.

These observations were made by the writer in the evening of June 8, 1938, while driving westward in gathering dusk through a rainstorm, in that part of northwestern Oklahoma which is called "The Panhandle." The country is table-like, treeless and sparsely settled. The road was excellent, and deserted, so that for twenty miles or more (during which no hills and only two curves were encountered) the machine was held at such a uniform speed that the period of the windshield wiper was very nearly constant. In the gathering night, the wiper blade could be seen only indistinctly except when illuminated by lightning. During a particularly brilliant flash, it was noticed that the wiper blade was executing an apparently stepwise movement (such as is sometimes seen when the blade and windshield are dry), although close inspection in the weak but steady light of twilight showed that it was moving steadily and smoothly on the thoroughly wet glass. Thereupon, the illusion of interrupted movement was recognized as the result of a periodic interruption in the source of illumination.

This observation of the stroboscopic behavior of the blade was made not less than 15 times during the storm. Not every flash showed the pulsating or multiple character. Nor did all flashes occur within those directional limits which permitted satisfactory observation. Presumably, in such a level, treeless area, many flashes are strokes to ground; and McEachron points out[2] that a high percentage of strokes to ground are multiple.

During a multiple flash the wiper blade appeared at 4 points (sometimes only 3), more or less uniformly spaced and all together occupying an arc which was about one third of the swing of the blade. Retinal retention and the duration of the flash may have mixed effects toward determining the number of blade images seen. Retinal fatigue also made it apparent that the intervals between the pulses were not quite uniform in length.

A count of the swings of the wiper showed it to be making from 115 to 120 half-vibrations per minute. The half-period was thus approximately 0.5 sec. The time occupied by the 4 blade images in one third the arc of the blade was 0.17 sec. Thus the average interval between the maxima of two successive pulses was 0.04 second.

This rough measurement, made with apparatus at hand, is not in disagreement with precise measurements made by McEachron and McMorris[3] from photographs made with a moving-lens camera employing the general principle of the Boys camera. Of 9 intervals which they recorded in a typical multiple stroke, the 5 intervals, 0.029, 0.028, 0.024, 0.022 and 0.053 sec., are of the same order as the 0.04 second reported here. Holzer, Workman and Snoddy[4] also report intervals as large as 0.033 and 0.047 sec., but they do not give the distribution of the intervals which they recorded.

The data given here are from a note-book entry of June 10, 1938. In consideration of the well-known detrimental effect which *prae judicio* knowledge may have upon any measurement in which the human factor is high, it may be noteworthy that at that time the observer had no information concerning the lengths of flash intervals, although he was aware that such data had been published.

H. M. DAVIS

SCHOOL OF MINERAL INDUSTRIES,
THE PENNSYLVANIA STATE COLLEGE

TYROSINE DETERMINATION

THE recent article by Reiter[1] raises the question as to whether the value given for the tyrosine content of egg albumin of 3.72 per cent. is to be taken as correct rather than the earlier values found by Looney[2, 3] of 4.20 and 4.10 per cent. If we assume that egg albumin has a molecular weight of 33,800 as proposed by Cohn[4] and contains 8 molecules of tyrosine, the calculated percentage composition would be 4.28. If the value of 35,700 given by Bergmann[5] is correct, then the theoretical percentage becomes 4.06. The value of 4.10 given by Looney[3] would appear to approach the theoretical value more nearly than the lower values given in the literature by other methods, and therefore the original method of Folin and Looney would still seem to be the most reliable method yet proposed. The method can also be used for 50 mg amounts of protid by reducing both the volume of the digest and also the final volume of the colored solution to 25 ml and all the reagents in proportion.

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[1] SCIENCE, 88: 2285, 352.

[2] *Elec. Engineering*, 53: 1633–37, 1934.
[3] *Gen. Elec. Rev.*, 39: 494, 1936.
[4] *Jour. Applied Phys.*, 9: 136, 1938.

[1] C. Reiter, SCIENCE, 88: 378, 1938.
[2] O. Folin and J. M. Looney, *Jour. Biol. Chem.*, 51: 421, 1922.
[3] J. M. Looney, *idem.*, 69: 1926.
[4] E. J. Cohn, J. L. Hendry and A. M. Prentiss, *Jour. Biol. Chem.*, 63: 721, 1925.
[5] M. Bergmann, *Chemical Reviews*, 22: 423, 1938.

A LINGUISTIC ANALYSIS OF THE SIXTEENTH INTERNATIONAL CONGRESS FOR PHYSIOLOGY

AT various international congresses, four languages are usually made official. This is especially true of the international congresses for physiology, the sixteenth of which met from August 14 to 19 last summer in Zurich. I have analyzed and classified various papers appearing on the program of that congress according to the languages in which they are presented with rather interesting results. Such a study obviously gives a sort of index to the languages most used in publishing or announcing the results of scientific investigation and also roughly indicates the amount of research carried on by the various peoples employing these mother tongues. The following are some of the statistical findings:

The total number of papers presented at the sixteenth International Congress for Physiology in Zurich last summer was 437. Of these, 211 were given in English, 143 in German, 59 in French and 24 in Italian. It is quite evident from these figures that the two languages most widely employed by the scientists were English and German, the sum of the two constituting over 80 per cent. of all the papers written. This, however, by no means indicates that a large amount of work is now being done in the Third Reich, because a further analysis of the 143 papers presented in German reveals that only 61 of these came from scientific workers in Nazi Germany; the rest of the communications in that language were read by a large number of German-speaking authors from other lands, including 10 from Czechoslovakia, 21 from Switzerland, 13 from the Netherlands, 4 from Austria, 9 from Hungary, 2 from Poland, 6 from Sweden, 1 from Norway, 3 from Palestine, 1 from Greece, 1 from Finland, 3 from Turkey, 2 from Italy, 1 from Esthonia and 1 from Belgium. Of the 211 English papers, 132 came from the United States and Canada; the rest emanated from the British Isles and other English possessions. Of the 59 French papers presented at the congress, 26 came from France, 17 from Belgium, 3 from Argentina, 1 from Italy, 2 from Poland, 1 from Portugal, 3 from Switzerland, 3 from Czechoslovakia, 1 from Serbia, 1 from Greece and 1 from Hungary. Of the Italian papers, 22 were presented by Italians; one was read by a Swiss and 1 by a Belgian.

The analysis made above becomes more interesting when it is compared with that of the thirteenth International Congress for Physiology, which met in Boston in 1929. At that congress also English and German were the dominating languages. The total number of papers listed was 585, of which 391 were in English and 106 in German, 62 in French and 23 in Italian. Of the 394 papers in English, 292 emanated from the United States, 26 from the British Isles, 14 from Canada, and the rest from other countries in various parts of the world. Of the 106 given in German, 61 (or 58 per cent. of the total) came from Germany itself. The remaining number consisted of 5 from Austria, 9 from Russia, 6 from Switzerland, 10 from Hungary, 9 from Czechoslovakia, 4 from the Netherlands and 2 from Esthonia. Of the 62 French communications, 37 came from France proper; the rest were presented by Belgians, Spaniards, Poles, Russians and Roumanians.

It is fair to assume that the number of members attending an international congress will vary inversely in proportion to the distance the individual scientists are obliged to travel from their place of origin to the place of meeting. Thus, when such a congress takes place in the United States, it is to be expected that the number of Americans and Canadians, and perhaps of English, attending the meeting will be greater than that of members coming from central Europe. *Vice versa,* when a congress meets in Switzerland, it is reasonable to suppose that a much larger number of scientists will come from such nearby countries as Germany, France and Italy than will arrive from across the water. An analysis of the members presenting papers at the two congresses, however, revealed the striking fact that there were actually just as many German papers presented at the Boston meeting in 1929 by those hailing from Germany proper as there were at the 1938 congress in Zurich. It is interesting to note that the number of French papers presented was very nearly the same at both the thirteenth and sixteenth International Congresses for Physiology; so also was the number of Italian papers.

The foregoing study warrants several tentative conclusions: First, it is obvious that the English language is more extensively used than any other as a medium of scientific communication and that the German comes second in popularity. Second, it is evident that nearly one half of the German communications made at the Zurich congress were presented not by Nazi physiologists but by German-speaking scientists widely distributed in other lands. Third, judging by the number of papers presented by Nazi physiologists at the Zurich congress as compared with the series read at the Boston congress in 1929 by scientists from Germany proper, it appears that the amount of scientific investigation (without any regard to its quality) now being done in the physiological sciences in the Third Reich is far below that produced there after the world war during the reign of democracy.

M. D.

SCIENTIFIC BOOKS

THE OPEN MIND

The Open Mind—Elmer Ernest Southard. By FREDERICK P. GAY. Publisher: Normandie House. $5.00.

IN a fascinating and excellently written biography, Dr. Gay has brought to life one of the unique and significant characters in American medicine of the past generation. This book is not merely the record of the scientific contributions to neuropathology of Ernest Southard nor the many ways in which he stimulated psychological thinking, but it is the portrait of a man whose inner vividness of *being* towered above his outer accomplishments.

To offer the reader an understanding of this singular person, the author has wisely selected much of his material from Southard's reflections about himself. Southard was irked by the fact that he was considerably over-weight, and in a letter to Mrs. Cabot remarked: "You know that in many people the soul is unlike the body—I, for instance, have a slim soul." What he was motivated by may be gathered by an excerpt from a letter to his mother: "It becomes increasingly difficult to figure out the technique of becoming a great man." The intensity with which Southard pursued the unusually wide trail of his many interests suggests that his impulse to be great sprang from an evolutionary flame that burned incessantly within him; this is revealed in Dr. Gay's book with incontestable clarity as a consuming interest in the unexplored. No one was more aware than he was himself of the multiple horizons on which he looked, as may be observed in this engaging admission: "Among psychologists I am known as a chess player . . .; among psychiatrists I am known as an anatomist; among philosophers I am known as a psychologist; and among clinicians as a neuropathologist . . . No man who has stayed within the recognized boundaries of his own field has contributed fundamentally to science."

His varied achievements in neuropathology, psychiatry and philosophy have been ably dealt with by the author, who was once his collaborator in research and always a lifelong friend. Southard's mind was early drawn to etymology and philology, and in his many later exhaustive studies of psychiatric and psychological formulations he employed his early training to classify disease types anew. In the opinion of the reviewer, his resistance to psychoanalytical theories can be traced to an urgent tendency to think of and define people in groups rather than to inspect a single individual in the prolonged, intensive analytical method of Freud. As Dr. Gay has pointed out, Southard strove to be fair as well as cautious in appraising Freud's major hypotheses. From the evidence provided by this book it must be acknowledged that his mind was not one to be easily harnessed to the hour-after-hour contemplation of a patient, often for years, which the psychoanalytical method requires for its therapeutic objective as well as for psychiatric research. He himself admitted a year before he died: "Perhaps it is in definition that I am most interested. Perhaps I believe that the world can get forward most by a clearer and clearer definition of fundamentals. Accordingly, I propose to stick to tasks of nomenclature and terminology, unpopular and ridiculous though they may be. A psychiatric dictionary (to include definitions of every near-lying psychological and philosophical term also) would do more to push mental hygiene on than any other single thing I can think of."

His interest in theories of integration of the personality led him to speculate and to write. To a house physician who asked him to see a patient on the ward, he replied: "Oh, I'm not interested in seeing a patient with that disease. I am writing a book on the subject." To a woman troubled with a disturbing tick or spasm of the face, which she thought might be a handicap in her career, he remarked: "My dear lady, we all have handicaps; my particular handicap is that I cannot make ward rounds." He was intensely interested in the possibility of demonstrating a relation between psychological function and anatomic structure, but it is in the field of pathology of the nervous system that he had his surest footing.

What was most startling about the man was the engaging charm and contagious enthusiasm which he emanated. An incredible number of his associates and pupils would subscribe to what Dr. E. T. F. Richards said of him: "I have not seen his equal in his remarkable ability to stimulate enthusiasm and the spirit of research in others." This subtle alchemy transmuted the interest of many of his friends from clinical practice into research into the unexplored domains of psychiatric medicine. Fortunately, Dr. Gay caught the virus Southard carried about with him and rescued it in a notable contribution to the biography of great personalities in American medicine.

ALVAN L. BARACH

FISH MANAGEMENT

The Improvement of Lakes for Fishing: A Method of Fish Management. By CARL L. HUBBS and R. W. ESCHMEYER. Bulletin No. 2, Institute for Fisheries Research, University of Michigan, Ann Arbor. 233 pp., 74 figs. May, 1938. $1.75.

MARKED increases in the number of anglers in the past two decades without any corresponding expan-

sion of fishable waters have stimulated great interest not only in maintaining fish yields in inland waters but also in projects designed to raise the yields to maximum carrying capacities. For more than half a century, the standard method of aiding fish production was the stocking of lakes and streams with hatchery-reared young fish. In general little or no attention was given to the environmental conditions that obtained in the waters that were stocked until recent years. More and more consideration has been given to various factors that have some influence on fish production in natural waters during the past decade. Up to the present time, such factors as shelter and breeding conditions have been emphasized.

The senior author of this bulletin has been chiefly responsible for the development of devices designed to improve environmental conditions in these respects; he is also responsible for trying these devices out on a large number of Michigan lakes. These experiments and the broad ichthyological knowledge of the authors constitute the fundamental background of the book.

Lake improvement is defined as the creation and maintenance in lakes of conditions which favor the propagation, growth and yield of inland lake fish. The general requirements for the successful production of fish are considered first; these include the physics and chemistry of the water, such as temperature, dissolved oxygen, hardness, depth, spawning conditions, suitable shelter and food supplies. All these subjects are more or less fully discussed, especially with reference to their general bearing on fish production under optimal conditions. The spawning habits of the different species of fish vary widely, for example, and successful reproduction, therefore, depends upon meeting the diverse requirements either naturally or artificially. Food is also a vital factor, so that fish production is substantially proportional to the food supply in the various types of water.

The second, or main, section of the book (pp. 49–201) deals with the construction of brush, log and other artificial structures designed to serve as shelters for fish and their installation in suitable locations. Also the planting of large aquatic plants, which will furnish natural shelters and feeding grounds, is discussed, as well as devices for bettering the spawning conditions. The use of fertilizers is recommended in certain types of lakes for the purpose of increasing the food supply. Methods of aerating the waters of shallow lakes in winter where there is frequently a heavy winter-kill due to the lack of dissolved oxygen are included in this section as well as the control of fish movements, the handling of fish populations showing stunted growth, the removal of excess rough fish, controlling predators and the treatment and prevention of diseases. The final chapter deals with the practicability of lake improvement and its place in fish management. This is followed by an annotated bibliography of 18 pages. The book is a valuable contribution to that phase of aquiculture which is concerned with the production of fish, and it fills a great need in this important field of water utilization.

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STATISTICAL TABLES

Statistical Tables for Biological, Agricultural and Medical Research. By R. A. FISHER and F. YATES. London and Edinburgh: Oliver and Boyd. 1938. viii + 90 pp. 12s. 6d net.

THESE tables will be of great value to research workers in the fields indicated and also in several others. Some of them are important for economic and sociological statisticians. The volume will have a wide appeal not only because of the eminence of the authors and the adequacy of the tables for an extensive range of work, but because the paper, type and arrangement have been well chosen to minimize time and eye-strain. The tables presented are:

I. The normal distribution. (Abscissae in terms of areas.) II. Ordinates of the normal distribution. III. Distribution of t. IV. Distribution of χ^2. V. Distribution of z and the variance ratio. VI. The correlation coefficient—values for different levels of significance. VII. The correlation coefficient—transformation of r to z. VIII. Tests of significance for a 2×2 contingency table. IX. Probits—transformation of the sigmoid dosage mortality curve to a straight line. X. Probits—simple quantiles of the normal distribution. XI. Probits—weighting coefficients and probit values to be used in adjustments of special accuracy. XII–XIV. The angular transformation. XV. Latin squares. XVI. Complete sets of orthogonal Latin squares. XVII–XIX. Balanced incomplete blocks. XX. Scores for ordinal (or ranked) data. XXI. Sums of squares of these scores. XXII. Initial differences of powers of natural numbers. XXIII. Orthogonal polynomials. XXIV. Calculation of integrals from equally spaced ordinates. XXV. Logarithms. XXVI. Natural logarithms. XXVII. Squares. XXVIII. Square roots. XXIX. Reciprocals. XXX. Factorials. XXXI. Natural sines. XXXII. Natural tangents. XXXIII. Random numbers. XXXIV. Constants, weights and measures, etc.

There is an excellent introduction describing the use of the tables, including some ingenious new uses of old tables, such as that of the χ^2 and variance ratio distributions for obtaining partial sums of the Poisson and binomial series, respectively. Other fruits of the authors' remarkable ingenuity include the work on Latin squares and balanced incomplete blocks in biological experiments, as well as other statistical methods

now better known. The section on interpolation at the end of the introduction must be read in order to use the tables efficiently; the methods of interpolation with reference to which several of the tables have been arranged will be novel to most statisticians.

Professor Fisher sends the following erratum. The formula for the range at the top of p. 8 should be

$$1/2PQ = 2/(1 - R^2).$$

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SPECIAL ARTICLES

THE TOXICITY AND ABSORPTION OF 2-SULFANILAMIDOPYRIDINE AND ITS SOLUBLE SODIUM SALT[1]

THE discovery of the chemotherapeutic activity of 2-sulfanilamidopyridine in experimental pneumococcus as well as streptococcus infections in mice[2] has led to a trial of the drug in human pneumococcus infections, as well as in various other bacterial diseases. The clinical use of 2-sulfanilamidopyridine was undertaken before a chemical description or any adequate pharmacological and toxicological study of the drug was reported. The only study of the toxicity of the drug is that reported by Wien,[3] who concluded "that this substance has a big advantage over sulfanilamide in being much less toxic," having "about one fourth the toxicity of sulfanilamide."

The above conclusion of Wien has been widely quoted. However, since all Wien's toxicity data were obtained by oral administration of an acacia suspension of the drug and since 2-sulfanilamidopyridine is a rather insoluble substance and is poorly absorbed, considerable doubt exists as to the validity of his conclusion. It has been shown that many sulfanilamide derivatives of low solubility owe their lack of toxicity to poor absorption from the gastro-intestinal tract, and it has been pointed out that determinations of the toxicity of such compounds administered by the oral route may be misleading because of low absorption when large doses are given.[4, 5, 6] Our finding, that when 2-sulfanilamidopyridine is given as its very soluble sodium salt, both the toxicity and the absorption are quite different from that of 2-sulfanilamidopyridine itself, would appear to justify the publication of this preliminary note.

The sodium salt of 2-sulfanilamidopyridine[7] was prepared as follows. One part of sulfanilamidopyridine was suspended in 20 volumes of boiling 95 per cent. alcohol, and 1.5 moles of 1.3 M alcoholic sodium hydroxide were added per mole of sulfanilamidopyridine. The solution was chilled 2 hours in ice, and the white crystalline precipitate filtered, washed with cold alcohol and dried at 110°. Yield, 80 per cent. Titration with standard acid and methyl red showed 98.9 per cent. purity; colorimetric analysis[8] indicated 100.1 per cent. purity. These values were essentially unchanged by recrystallization from 95 per cent. alcohol. In this colorimetric analysis, it is important to note that unless the solution of the sodium salt is treated with the strong trichloroacetic acid solution before dilution, considerably lower (about 8–10 per cent.) results are obtained. On this account, further work was done with the sodium salt to establish its purity. One gram of sodium salt was titrated with standard acid to neutrality using methyl red, the precipitate was filtered off, washed with a small amount of cold water, and dried at 110° for a few minutes and drying completed in a vacuum desiccator. A 97.1 per cent. recovery of the sulfanilamidopyridine resulted, m. p. 190.4–190.9°, unchanged by admixture with a carefully purified sample of the original material. The sodium salt was prepared also by adding sufficient alcohol to completely dissolve the sulfanilamidopyridine, adding alcoholic sodium hydroxide to the solution and immediately cooling. Yield, 71 per cent. A third preparation of the sodium salt was made without the use of alcohol, by dissolving the sulfanilamidopyridine in 1.5 moles of warm 3 M aqueous sodium hydroxide and chilling. Yield, 60 per cent. (A further 20 per cent. yield may be obtained by adding 20 parts of absolute alcohol to the mother liquor). The sodium salts prepared by all three methods appeared to be identical. We have no explanation to offer for the low results which are obtained by the usual colorimetric method.

The sodium salt is a white product, crystallizing from 95 per cent. alcohol in clusters of radiating thin rods. It melts with decomposition at 316.5–317°. Its solubility in the non-aqueous solvents is low, as would be expected of an organic sodium salt. It dissolves in water to the extent of approximately 63 grams per 100 cc (25°). The pH of a 1 per cent. aqueous solution is 10.4; that of a 10 per cent. solution, 11.0.

Acetylsulfanilamidopyridine was prepared by treatment of a warm aqueous solution of the hydrochloride

[1] This investigation has been aided by a grant from The John and Mary R. Markle Foundation.

[2] Whitby, *Lancet*, 1: 1210, 1938.

[3] Wien, *Quart. Jour. Pharmacy and Pharmacology*, 11: 217, 1938.

[4] Marshall, Cutting and Emerson, *Jour. Am. Med. Assn.*, 110: 252, 1938.

[5] Marshall, Cutting and Cover, *Bulletin Johns Hopkins Hosp.*, 63: 318, 1938.

[6] Finestone, Bliss, Ott and Long, *Bulletin Johns Hopkins Hosp.*, 62: 565, 1938.

[7] The 2-sulfanilamidopyridine was kindly furnished by Merck and Company and by the Calco Chemical Company.

[8] Sulfanilamidopyridine can be estimated by the same procedure as used for sulfanilamide.[9, 10]

of sulfanilamidopyridine with acetic anhydride, followed by addition of sodium acetate. Recrystallized from 30 per cent. acetic acid, it melted at 225.6–226.3°. Its sodium salt was prepared in boiling alcoholic solution as described above and precipitated by the addition of 250 parts of ether.

A study was made in mice of the blood concentration-time curves of sulfanilamidopyridine administered orally either as an acacia suspension of the free acid or as a solution of the sodium salt. Blood concentrations were determined by the method previously described for sulfanilamide.[9, 10, 11] Doses of 0.4, 1.0, 3.0, 6.0 and 16.0 grams per kilogram of the acacia suspension yielded blood values of increasing amount, but these values were not at all proportional to the dose. The maximum blood concentrations attained with 6 and 16 grams were around 50 mgm per cent., but in some instances blood levels reached by 6 were greater than those with 16 grams. On the other hand, when the extremely soluble sodium salt was given, it was more readily absorbed, and blood levels attained with doses of 0.4, 1.0 and 2.0 grams[12] per kilogram were roughly proportional to the dose. The maximum blood levels obtained with 1 gram (40 mgm per cent.) were nearly as high as with 16 grams of the suspension, while 2.0 grams gave blood levels of 65 mgm per cent. or over—higher than those obtained with eight times this amount in the form of a suspension of the difficultly soluble acid itself.

When a solution of sodium sulfanilamidopyridine is given to mice *per os,* the toxicity of the substance is greater than that of sulfanilamide. Thus, all in groups of ten mice given 3.0 and 4.0 grams per kilogram died, 60 mice given 2.0 grams gave 50 per cent. mortality, and ten mice given 1.0 gram had severe symptoms but all survived. The symptoms caused by this drug were quite different from those seen after toxic doses of sulfanilamide in that more stimulation and less depression of the nervous system occurred. A rigidity of the tail (the Straub morphine reaction) appeared first, then violent excitement with ataxia, dyspnoea and tetanic convulsions followed by a mixed type occurred. These symptoms appeared in one-quarter hour, and death occurred in less than 4 hours. The blood levels in mice at death have varied from 70 to 94 mgm per cent. (average 83). The administration of an amount of sodium carbonate solution equivalent in base to 4.0 grams per kilogram of sodium sulfanilamidopyridine to mice caused no symptoms. Wien has given the $L D_{50}$ for mice as 16.6 grams per kilogram, a figure about 8 times as great as our value found by using the sodium salt. We have attempted to check Wien's determination of the toxicity of an acacia suspension of the free acid, but due to erratic absorption with large doses and deaths at quite low blood levels, we concluded that the method was worthless and that death may not be the result of the real toxicity of the drug. However, we observed the same symptoms 1 to 3 hours after giving the acacia suspension of the free acid. Wien found that a dog given 1 gram per kilogram of the 2-sulfanilamidopyridine *per os* daily for seven days exhibited no symptoms. We gave a small dog on two occasions a single dose of 1.0 gram per kilogram of the sodium salt, and although a large part of the dose was vomited, the animal showed severe symptoms in the form of tonic and clonic convulsions with occasional opisthotonos. (The maximum blood concentration was 33 mgm per cent.) Another dog given 1.0 gram per kilogram subcutaneously exhibited the same severe symptoms and died with a blood level of 62 mgm per cent.

Blood concentration-time curves and the percentage excretion of the drug in the urine were studied in dogs to which 0.1 gram per kilogram was administered in different ways by mouth. When sulfanilamidopyridine was given without water in gelatin capsules or compressed tablets absorption was poor and erratic. The administration of water with the drug had no influence on absorption in the case of capsules, but did appear to increase absorption when tablets were used; also, when given suspended in acacia or water, absorption was more rapid. The greatest, most rapid and regular absorption was seen when the drug was given dissolved in hydrochloric acid or in sodium bicarbonate solution or as the soluble sodium salt.

These observations appear to indicate that four factors condition the absorption in dogs: (1) the solubility of the preparation, (2) the particle size, (3) the state of suspension, and (4) the rapidity of passage of the drug from stomach to intestine. Since in the case of patients given tablets of sulfanilamidopyridine absorption appears to be erratic,[13] various methods of administration are being tried on man in order to obtain more complete and constant absorption.

Sulfanilamidopyridine is apparently excreted unchanged in the urine of the dog, but in the rabbit and man it is excreted partly in the free and partly in a conjugated form. In the mouse, only a very small amount of the drug appears to be conjugated. One of us (B) has isolated the conjugated form from the urine of a patient receiving the drug and found it to be p-acetylaminobenzenesulfamidopyridine. Since this substance is even less soluble than the sulfanilamidopyridine and probably less readily absorbed, its sodium salt has been used for toxicity determination in mice.

[9] Marshall, *Jour. Biological Chemistry,* 122: 263, 1937.
[10] Marshall and Litchfield, SCIENCE, 88: 85, 1938.
[11] Marshall and Cutting, *Bulletin Johns Hopkins Hosp.,* 63: 328, 1938.

[12] All values for doses and blood concentrations are expressed in terms of sulfanilamidopyridine.
[13] Long: Personal communication.

Of ten mice given 4.0 grams per kilogram five died; the blood levels in two at death were found to be 77 and 106 mgm per cent. It appears that the acetyl-derivative of sulfanilamidopyridine is of the same order of toxicity as the unconjugated compound if blood concentrations are taken into consideration.

In conclusion, we wish to emphasize that sulfanilamidopyridine on the basis of blood concentration values appears to be more toxic than sulfanilamide. Until more is known about the drug, it should not be used in conditions where sulfanilamide has been shown to be effective.

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THE APPLICATION OF THE NITROGEN ISOTOPE N^{15} FOR THE STUDY OF PROTEIN METABOLISM

THE production of nitrogen with an increased concentration of the isotope of atomic weight 15 (N^{15}) by Urey and his collaborators has opened the possibilities of investigating the metabolism of amino acids, proteins and other nitrogenous compounds in normal healthy animals. The principles underlying the procedure are similar to those which have been successfully employed in the investigation of the fate of fats, steroids and other compounds, with deuterium as a tracer. The substance to be investigated is synthesized in the laboratory in such a manner that one of its atoms contains an increased concentration of isotope, in the present case[1] by starting the synthesis with ammonia N^{15}. The rarity and value of the isotopic ammonia compelled the development of methods for amino acid synthesis which should lead to complete recovery of the isotope. The methods employed were modifications of the phthalimide synthesis of Gabriel and of the catalytic reduction of α-keto acids in the presence of ammonia according to Knoop. The following isotopic and racemic amino acids are now available for biological investigations, all of which contain nitrogen with more than 2 per cent. N^{15} as compared with the normal abundance of 0.368 per cent.: glycine, alanine, nor-leucine, tyrosine, phenylalanine, glutamic acid, aspartic acid, lysine and leucine. The latter compound also contains, besides the nitrogen isotope, stably (carbon) bound deuterium, and has been resolved in the laboratory into its optical isomers.

The biological application of such substances requires a highly sensitive micro method for the analysis of the N^{15} content in the nitrogen of organic compounds. The only practical procedure requires the use of a mass spectrometer. The nitrogen of the compound is converted to ammonia, elementary nitrogen is liberated from it in a high vacuum system and this admitted to the vacuum tube containing the mass spectrometer proper. In this tube the gas is ionized and under the influence of electric and magnetic fields is dispersed into a spectrum of the component masses. The instrument constructed in our laboratory requires less than 1 mg of nitrogen for an analysis and has a sensitivity of 0.003 per cent. N^{15} when normal nitrogen is analyzed. Any of the amino acids listed above can thus be mixed *in vivo* or *in vitro* with several hundred times its weight of the normal analogue before the analytical methods miss the isotope label.

The concentration of N^{15} in the nitrogen of ordinary casein as well as of ten different natural amino acids was determined and found to be the same as in the nitrogen of air, a finding which indicates that both isotopes of nitrogen are treated indiscriminately in anabolic and catabolic processes.

The nitrogen in organic linkage, as for example in amino acids, is stably bound and does not exchange with the nitrogen of other nitrogenous compounds with which it is brought in contact. This was established by the investigation of ten different systems, each of which contained one normal and one isotopic compound. Whenever, in experiments either *in vivo* or *in vitro,* compounds are observed which contain more than the normal abundance of isotopic nitrogen, the formation of such compounds must therefore be ascribed to chemical reactions.

An investigation on hippuric acid formation has already been reported[2]; other experiments on protein metabolism have now been carried out. The first is concerned with the much discussed question as to whether the animal organism can utilize the nitrogen of dietary ammonia for amino acid formation. Rats were given an ordinary stock diet to which were added benzoic acid and isotopic nitrogen as ammonium citrate. The experimental conditions under which the animals were kept were so chosen that most of the glycine excreted in the urine as hippuric acid was newly formed. This contained a small but significant amount of isotope, indicating that a small part of the glycine had been formed from ammonia nitrogen.

Another experiment carried out with immature rats was still more illuminating. The animals were given a protein-low diet to which isotopic ammonium citrate had been added. After five days they were killed, the carcasses were hydrolyzed and the following compounds were isolated in pure form; glycine, glutamic acid, aspartic acid, proline, histidine, lysine, arginine and creatine. All, with the exception of lysine, con-

[1] The authors are highly indebted to Professor H. C. Urey for the valuable gift of nitrogen isotope.

[2] R. Schoenheimer, D. Rittenberg, M. Fox, A. S. Keston and S. Ratner, *Jour. Am. Chem. Soc.*, 59: 1768, 1937.

tained a small amount of the nitrogen isotope. Both experiments must be taken as proof that at least a small amount of creatine and amino acids can be formed with ammonia as a nitrogen donor and that dietary ammonia may be utilized for this process.

In another experiment the fate of one dietary amino acid, tyrosine, was followed in a full-grown adult rat kept in nitrogen equilibrium on a normal diet, the protein of which consisted of casein. To this was added an amount of isotopic *dl*-tyrosine corresponding to only 14.4 mg nitrogen addition per day. The animal was kept on this diet for ten days. It excreted an amount of total nitrogen equivalent to that in the total diet, but about half of the isotope was retained by the tissues. The retention must have been accompanied by the liberation (for excretion) of an equivalent amount of nitrogen. The liver and the remaining carcass were worked up separately to locate the isotope. Almost all of it was recovered in the proteins, while the non-protein-nitrogen revealed only traces. Both liver and carcass proteins were hydrolyzed, and pure tyrosine was isolated. The samples contained a high concentration of isotope, indicating an extensive deposition of the dietary tyrosine in the body proteins. However, the isotope content in tyrosine accounted for only about one quarter of the total isotope content in the proteins. Amino acids, other than tyrosine, must thus have taken up nitrogen originally present in tyrosine. This could be proved. The following other amino acids were isolated: arginine, lysine, histidine and the mixture of the dicarboxylic acids, glutamic and aspartic acid. With the exception of lysine, all of them contained a significant amount of isotopic nitrogen. As the dicarboxylic acids contain only 1 nitrogen atom per molecule, the position in the molecule of the newly introduced nitrogen is certain. The position of the isotope in the arginine and histidine, both of which contain more than one nitrogen atom per molecule, had to be investigated. The arginine isolated was split into ornithine and urea. All the isotope was found in urea moiety, while the ornithine contained normal nitrogen. The α-amino group of histidine was removed by converting the amino acid into imidazole lactic acid. The latter contained normal nitrogen; all the isotope must have been in the α-amino group of the original histidine.

The experiment shows that in a normal full-grown and healthy animal, kept on a normal diet, the nitrogen of at least one of the dietary amino acids, tyrosine, is only partly excreted in the urine, while the rest is retained in the protein of the animal, with a corresponding excretion of tissue nitrogen. Only a fraction of the nitrogen deposited remains attached to the original carbon chain of the amino acid, with which it was given, the bulk being utilized in the formation of some other amino acids. Degradation of some of the isolated amino acids has given some insight into the processes which must have been responsible for their formation:

(1) The dicarboxylic acids containing only one nitrogen atom were either newly synthesized from substances with different carbon chains or underwent deamination followed by amination of the remaining keto acid. Whichever of these two processes was responsible, its occurrence was not suppressed by the abundance of these substances in the dietary protein, casein.

(2) Arginine was formed from ornithine, probably in the course of urea formation, according to the theory of Krebs.

(3) Histidine was successively deaminated and reaminated at the α-carbon atom alone.

(4) Ornithine and lysine are apparently not subject to such processes.

All these reactions had occurred with constituents of the proteins of a normal animal and reveal an extensive chemical activity of its proteins.

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BOOKS RECEIVED

Brooklyn Botanic Garden Record; Vol. XXVII, No. 3, July, 1938; Contents: Botanic Gardens of the World; Materials for a History. Second edition. Pp. 151-406. Brooklyn Institute of Arts and Sciences. $2.50.

DEN HARTOG, J. P., and others. *Contributions to the Mechanics of Solids Dedicated to Stephen Timoshenko by his Friends on the Occasion of his Sixtieth Birthday Anniversary.* Pp. vii + 277. Illustrated. Macmillan. $5.00.

FAIRCHILD, DAVID. *The World Was my Garden; Travels of a Plant Explorer.* Pp. xiv + 494. Illustrated. Scribner's. $3.75.

Fondation Universitaire. *Statistiques des Diplômés de l'Enseignement Supérieur en Belgique.* Pp. 99. Universitaire Stichting, Brussels.

GIDDENS, PAUL H. *The Birth of the Oil Industry.* Pp. xxxix + 216. Illustrated. Macmillan. $3.00.

LICHTIG, IGNAZ. *Die Entstehung des Lebens; Durch Stetige Schöpfung.* Pp. xx + 371. 4 figures. Noord-Hollandsche Uitgevers Maatschappij, Amsterdam. Gulden 6.

NEEDHAM, JOSEPH, and WALTER PAGEL, Editors. *Background to Modern Science; Ten Lectures at Cambridge Arranged by the History of Science Committee, 1936.* Pp. xii + 243. Macmillan. $2.00.

RITTER, WILLIAM E. *The California Woodpecker and I.* Pp. xiii + 340. 28 figures. University of California Press. $3.50.

TOLMAN, RICHARD C. *The Principles of Statistical Mechanics.* Pp. xix + 660. Oxford University Press. $9.00.

ULICH HERMANN. *Kurzes Lehrbuch der Physikalischen Chemie.* Pp. xv + 315. 79 figures. Steinkopff, Dresden. RM 12.